PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT(S)	:	Leonard L. Diaddario, Jr.
TITLE	:	USE OF N-ALLYL SUBSTITUTED AMINES AND THEIR SALTS AS BRIGHTENING AGENTS IN NICKEL PLATING BATHS
APPLICATION NO.	:	10/774,558
FILED	:	February 9, 2004
CONFIRMATION NO.	:	8970
EXAMINER	:	Edna Wong
ART UNIT	:	1753
LAST OFFICE ACTION	:	April 19, 2006
ATTORNEY DOCKET NO.	:	PVOZ 2 00016 Cleveland, OH 44114 October 2, 2006

DECLARATION

The undersigned declares as follows:

1. I, Leonard L. Diaddario, Jr. am the inventor listed in U.S. Patent Application No. 10/774,558, filed February 9, 2004.

2. I currently hold the position of Senior Research Chemist with Pavco, Inc. and have held this position for nine (9) years.

3. Prior to joining Pavco, I worked for seventeen (17) years in the field of Industrial Chemistry, holding such positions as Senior Chemist, Project Leader, and Staff Chemist with Celanese Corporation and Hoechst Celanese Corporation.

4. My educational background includes a doctorate degree in Analytical Chemistry from Wayne State University as well as a master's degree and bachelor's degree in chemistry also.

5. It is my opinion that the relevant art for the aforementioned patent application is the nickel plating bath art.

6. From my experience a person of ordinary skill in the nickel plating bath would be a person that has at least a bachelor's and/or master's degree in chemistry and two (2) to three (3) years of experience in the nickel plating field.

7. As part of my responsibilities as a Senior Chemist for Pavco, I was asked to review the aforementioned patent application and opine on the meaning of "n" in the following chemical formula $[H_2C=CHCH_2N^+R_1R_2R_3]_nX^{n-}$.

8. This is a matter of ionic chemistry.

9. The concept is that the quaternary amine compound $[H_2C=CHCH_2N^+R_1R_2R_3]_nX^{n-}$ has a positive charge of +1 and that the n-valent inorganic or organic anion has a negative charge of n-.

10. It is known in ionic chemistry that a neutral charge is desired for the entire molecule, as such n number of the quaternary amine compounds must be present to neutralize the negative charge of the anion.

11. Therefore, n is the positive integer of the value of n-.

12. In the application, the following examples of X^{-n-} are given: chloride, bromide, fluoride, sulfate, acetate and tetrafluoroborate and the anions have the following charges: chloride, bromide, fluoride, acetate and tetrafluoroborate all have a

charge of -1; and sulfate has a charge of -2. Therefore, for the examples of X^{n-} given in paragraph 20 of the application, n would be 1 or 2.

13. It is my recollection that this would be an issue which would typically be taught in a freshmen chemistry class.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Respectfully submitted,

By Leonard L. Diaddario, Jr.

Printed Name: Leonard L. Diaddario, Jr.

Date: 10/2/06

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11. Manchester College **Chemistry** course descriptions
... overview of the basic theory and **principles** of general and inorganic **chemistry**. ... and **ionic** compounds; application of thermodynamic **principles** and descriptive ...
manchester.edu/Academics/departments/**chemistry**/course_descriptions.htm - 21k - Cached - More from this site - Save

12. Rockhurst University Department of **Chemistry**
Principles of General **Chemistry** (3) ... **ionic** bonding) as commonly taught in the first semester of a general **chemistry** course. ...
www.rockhurst.edu/academic/**chemistry**/courses.asp - 29k - Cached - More from this site - Save

13. The WebScience Project at IUPUI
C105/C111 **Principles** of **Chemistry** I. WarmUp exercises. GoodFors. Puzzles. Dimensional Analysis ... Ions and **Ionic** Compounds. Lewis Dot Structures. Shapes of ...
webphysics.iupui.edu/webscience/**chemistry**_archive.html - 14k - Cached - More from this site - Save

14. Chemical **Principles**
Transition Metals and Coordination **Chemistry**. 20.1. The Transition Metals: A Survey ... Partial **Ionic** Character of Covalent Bonds. 13.7. The Covalent ...
www.sas.upenn.edu/chem/ugrad/chem**Principles**.html - 18k - Cached - More from this site - Save

15. **Chemistry**
... data, the systematic treatment of **ionic** equilibria and titrations, and the ... emphasizes the study of chemical **principles** in the context of contemporary ...
newton.uor.edu/Departments&Programs/**Chemistry**Dept/**Chemistry**.html - 18k - Cached - More from this site - Save

Exhibit B

CALIFORNIA INSTITUTE OF TECHNOLOGY

CALTECH CATALOG

2006

The online version of the Caltech Catalog is provided as a convenience; however, the printed version is the only authoritative source information about course offerings, option requirements, graduation requirements, and other important topics.

Chemistry

Ch 1 ab. General Chemistry. *6 units (3-0-3) first term; 9 units (4-0-5) second term.* Lectures and recitations dealing principles of chemistry. First term: electronic structure of atoms, periodic properties, ionic substances, covalent bonding representations of molecules and ions, shapes of molecules, Lewis acids and bases, Bronsted acids and bases, hybridizai resonance, bonding in solids. Second term: chemical equilibria, oxidation and reduction, thermodynamics, kinetics, intro organic chemistry and the chemistry of life. Graded pass/fail. Instructors: Lewis, Heath. Additional information concernir course can be found at http://www.its.caltech.edu/~chem1.

Ch/APh 2. Introduction to Energy Sciences. *9 units (4-0-5); third term. Prerequisites: Ch 1 ab, Ph 1 ab, Ma 1 ab.* E production and transduction in biological, chemical, and nuclear reactions. Bioenergetics: energy sources and storage; c of biological energy flows: pumps, motors, and solar cells; circuitry of biological energy flows and biological energy trans pathways. Chemistry of energy production and utilization: fossil fuel utilization and energy conversion pathways; artificia photosynthesis, solar cells, and solar energy conversion. Principles of nuclear energy production: nuclear energy decay p fission and fusion reactions, and reactor principles. Not offered on a pass/fail basis. Instructors: Lewis, Bellan, D. Newm. *the menu requirement of the Caltech core curriculum.* Not offered 2006–07.

Ch 3 a. Fundamental Techniques of Experimental Chemistry. *6 units (0-5-1); first, second, third terms.* Introduce principles and techniques of synthesis and analysis and develops the laboratory skills and precision that are fundamenta experimental chemistry. Freshmen who have gained advanced placement into Ch 41 or Ch 21, or who are enrolled in Ch encouraged to take Ch 3 a in the fall term.Graded pass/fail. Instructor: Staff.

Ch 3 b. Experimental Procedures of Synthetic Chemistry. *8 units (1-6-1); third term. Prerequisites: Ch 1 a, Ch 1 b a.* Instruction in fundamental synthesis, separation, and characterization procedures used in chemical research. Instruct

Ch 4 ab. Synthesis and Analysis of Organic and Inorganic Compounds. *9 units (1-6-2). Prerequisites: Ch 1 (or th equivalent) and Ch 3 a.* Previous or concurrent enrollment in Ch 41 is strongly recommended. Introduction to methods c separation, purification, and characterization used routinely in chemical research laboratories. Ch 4 a emphasizes spectr methods of analysis; Ch 4 b stresses applications of chromatography in addition to more classical separation techniques first term; Ch 4 b, second term only. Instructor: Staff.

Ch 5 ab. Advanced Techniques of Synthesis and Analysis. *Ch 5 a 12 units (1-9-2); Ch 5 b 9 units (1-6-2); third, s terms, respectively. Prerequisite: Ch 4 ab. Ch 102 strongly recommended for Ch 5 b.* Modern synthetic chemistry. Speci experiments may change from year to year. Experiments illustrating the multistep syntheses of natural products (Ch 5 a coordination complexes, and organometallic complexes (Ch 5 b) will be included. Methodology will include advanced tecl synthesis and instrumental characterization. Terms may be taken independently. Instructor: Dougherty. Part b not offer 07.

Ch 6 ab. Application of Physical Methods to Chemical Problems. *10 units (0-6-4); second, third terms. Prerequisit Ch 4 ab, and Ch 21 or equivalents (may be taken concurrently).* Introduction to the application of modern physical meth chemical problems, with emphasis in the area of molecular spectroscopy. Techniques including X-ray crystallography, la spectroscopy, microwave spectroscopy, electron spin resonance, ultraviolet photoelectron spectroscopy, and Fourier tra cyclotron resonance spectroscopy are used to examine the structure, properties, and reaction dynamics of molecules in phase, in solution, and at surfaces. Instructors: Okumura, Beauchamp, Collier.

Ch 7. Advanced Experimental Methods in Bioorganic Chemistry. *9 units (1-6-2); third term. Prerequisites: Ch 41 Bi/Ch 110, Ch 4 ab. Enrollment by instructor's permission. Preference will be given to students who have taken Ch 5 a o* advanced laboratory course will provide experience in the powerful contemporary methods for polypeptide and oligonucl synthesis. Experiments will address nucleic acid and amino acid protecting group strategies, biopolymer assembly and is product characterization. A strong emphasis will be placed on understanding the chemical basis underlying the successfu of these procedures. In addition, experiments to demonstrate the application of commercially available enzymes for use organic transformations will be illustrated. Instructor: Hsieh-Wilson.

Ch 10 abc. Frontiers in Chemistry. *3 units (2-0-1); first, second terms. 8 units (1-6-1); third term. Open for credit tc and sophomores. Prerequisites: Ch 10 c prerequisites are Ch 10 ab, Ch 3 a, and either Ch 1 ab, Ch 41 ab, or Ch 21 ab, instructor's permission.* Ch 10 ab is a weekly seminar by a member of the chemistry department on a topic of current re topic will be presented at an informal, introductory level. The other weekly session will acquaint students with the labora techniques and instrumentation used on the research topics. Ch 10 c is a research-oriented laboratory course, which wil supervised by a chemistry faculty member. Weekly class meetings will provide a forum for participants to discuss their r projects. Graded pass/fail. Instructors: Barton, Dervan.

Ch 14. Chemical Equilibrium and Analysis. *6 units (2-0-4); third term.* A systematic treatment of ionic equilibria in s Topics covered include acid-base equilibria in aqueous and nonaqueous solutions, complex ion formation, chelation, oxid reduction reactions, and some aspects of reaction mechanisms. Instructors: Rees, Richards.

Ch 15. Chemical Equilibrium and Analysis Laboratory. *10 units (0-6-4); first term. Prerequisites: Ch 1 ab, Ch 3 a, instructor's permission.* Laboratory experiments are used to illustrate modern instrumental techniques that are currently in industrial and academic research. Emphasis is on determinations of chemical composition, measurement of equilibriur constants, evaluation of rates of chemical reactions, and trace-metal analysis. Instructor: Staff.

Ch 21 abc. The Physical Description of Chemical Systems. *9 units (3-0-6); first, second, third terms. Prerequisites Ph 2 ab, Ma 2 ab.* Atomic and molecular quantum mechanics, spectroscopy, thermodynamics, statistical mechanics, and kinetics. Instructors: McKoy, Blake, Okumura.

Ch 24 ab. Introduction to Biophysical Chemistry. *9 units (3-0-6); second, third terms. Prerequisites: Ma 1 abc, Ph 21 a or Ph 2 ab.* Fundamental physical chemistry, with emphasis on those topics most important in biology. Thermodyna its applications to aqueous solutions and living systems, membrane potentials and the thermodynamics of transport, rea kinetics and mechanisms, transport properties, applications of molecular spectroscopy in biology, and statistical mechan applications to biological polymers. Instructors: Rees, S. Chan.

Ch 41 abc. Organic Chemistry. *9 units (3-0-6); first, second, third terms. Prerequisite: Ch 1 ab or instructor's permis* synthesis, structures, and mechanisms of reactions of organic compounds. Instructors: Grubbs, Dervan, Stoltz.

Ch 80. Chemical Research. *Offered to B.S. candidates in chemistry. Units in accordance with work accomplished. Prer consent of research supervisor.* Experimental and theoretical research requiring a report containing an appropriate descr the research work.

Ch 81. Independent Reading in Chemistry. *Units by arrangement. Prerequisite: instructor's permission.* Occasional a work involving reading assignments and a report on special topics. No more than 12 units in Ch 81 may be used as elec chemistry option.

Ch 90. Oral Presentation. *3 units (2-0-1); second term.* Training in the techniques of oral presentation of chemical an biochemical topics. Practice in the effective organization and delivery of technical reports before groups. Graded pass/fa Instructors: Zewail, Bikle.

Ch/ChE 91. Scientific Writing. *3 units (1-0-2); third term.* Training in the writing of scientific research papers. Each s must complete a 3,000-word paper styled after an article in the *Journal of the American Chemical Society* on a subject c or biochemical relevance. The manuscript may be based on a paper submitted by the student for a previous class or on report, but it must be the student's original writing and be within the intellectual scope of the chemistry and chemical er division. Each student will work individually with a faculty member under the supervision of the course instructor. *Fulfills Institute scientific writing requirement.* Instructor: Weitekamp.

Ch 102. Introduction to Inorganic Chemistry. *9 units (3-0-6); third term. Prerequisite: Ch 41 ab.* Structure and bor inorganic species with special emphasis on spectroscopy, ligand substitution processes, oxidation-reduction reactions, ar inorganic chemistry. Letter grades only. Instructor: Peters.

Bi/Ch 110. Introduction to Biochemistry. *12 units (4-0-8).* For course description, see Biology.

Bi/Ch 111. Biochemistry of Gene Expression. *12 units (4-0-8).* For course description, see Biology.

Ch 112. Inorganic Chemistry. *9 units (3-0-6); first term. Prerequisite: Ch 102 or instructor's permission.* Introductior theory, ligand field theory, and bonding in coordination complexes and organotransition metal compounds. Systematics synthesis, bonding, and reactivities of commonly encountered classes of transition metal compounds. Instructor: Bercav

Bi/Ch 113. Biochemistry of the Cell. *12 units (4-0-8).* For course description, see Biology.

Ch 117. Introduction to Electrochemistry. *6 units (2-0-4); second term.* Discussion of the structure of electrode-ele interface, the mechanism by which charge is transferred across it, and experimental techniques used to study electrode Topics change from year to year but usually include diffusion currents, polarography, coulometry, irreversible electrode the electrical double layer, and kinetics of electrode processes. Not offered 2006–07.

Ch 120 abc. Nature of the Chemical Bond. *9 units (3-0-6) first term; 6 units (2-0-4) second term; 9 units (1-1-7) th Prerequisite: general exposure to quantum mechanics (e.g., Ph 2 ab, Ph 12 abc, or equivalent).* Modern ideas of chemic with an emphasis on qualitative concepts and how they are used to make predictions of structures, energetics, excited s properties. Part a: The quantum mechanical basis for understanding bonding, structures, energetics, and properties of n (polymers, ceramics, metals alloys, semiconductors, and surfaces). The emphasis is on explaining chemical, mechanical and thermal properties of materials in terms of atomistic concepts. Part b: The quantum mechanical basis for understan transition metal systems with a focus on chemical reactivity. There will be an emphasis on organometallic complexes, or homogeneous catalysis, and on heterogeneous catalysis. Part c: The student does an individual research project using n quantum chemistry computer programs to calculate wavefunctions, structures, and properties of real molecules. Not offi 07.

Ch 121 ab. Atomic Level Simulations of Materials and Molecules. *9 units (1-1-7) second, third terms. Prerequisite Ph 2 ab, Ch 1 ab, or equivalent. Recommended: Ch 41 abc, Ch 21 a.* Methods for predicting the structures and propertie molecules and solids. The course will highlight theoretical foundations and applications to current problems in the followi biological systems (proteins, DNA, carbohydrates, lipids); polymers (crystals, amorphous systems, copolymers); semico (group IV, III-V, surfaces, defects); inorganic systems (ceramics, zeolites, superconductors, and metals); and organom catalysis (heterogeneous and homogeneous). Both terms will involve the use of computers for building and calculating s interest. Part a covers the basic methods. Part b will focus on simulations applied to problems in petroleum chemistry. C recommended but not required for Ch 121 a. Not offered 2006–07.

Ch 122 abc. Methods for the Determination of the Structure of Molecules. *9 units (3-0-6); first, second, third ter Prerequisite: Ch 21 abc or instructor's permission.* Modern methods used in the determination of the structure of molecu three terms can be taken independently. Ch 122 a (small molecule X-ray crystallography) will be offered first term. Part not offered 2006–07. Instructor: Day.

Ch 125 abc. The Elements of Quantum Chemistry. *9 units (3-0-6);first, second, third terms. Prerequisite: Ch 21 ab equivalent brief introduction to quantum mechanics.* A first course in molecular quantum mechanics consisting of a quan treatment of quantum mechanics with applications to systems of interest to chemists. The basic elements of quantum m the electronic structure of atoms and molecules, the interactions of radiation fields and matter, scattering theory, and re theory. Instructors: Kuppermann, McKoy, Weitekamp.

Ch 126. Molecular Spectra and Molecular Structure. *9 units (3-0-6); third term. Prerequisite: Ch 21 and Ch 125 a concurrently, or instructor's permission.* Quantum mechanical foundations of the spectroscopy of molecules. Topics inclu quantum theory of angular momentum, rovibrational Hamiltonian for polyatomic molecules, molecular symmetry and pe inversion groups, electronic spectroscopy, interaction of radiation and matter. Instructor: Collier.

Ge/Ch 127. Nuclear Chemistry. *9 units (3-0-6).* For course description, see Geological and Planetary Sciences.

Ge/Ch 128. Cosmochemistry. *9 units (3-0-6).* For course description, see Geological and Planetary Sciences.

Ch 130. Spectroscopy. *9 units (3-0-6); third term.* Discussion of various topics in lasers and their applications. Group applications to molecular structure and spectroscopy will also be discussed. Not offered 2006–07.

Bi/Ch 132. Biophysics of Macromolecules. *9 units (3-0-6).* For course description, see Biology.

Ch 135 ab. Chemical Dynamics. *9 units (3-0-6); part a, third term; part b, second term. Prerequisites: Ch 21 abc an abc, or equivalent, or instructor's permission.* Part a: introduction to the dynamics of chemical reactions. Topics include cross sections, rate constants, intermolecular potentials, reactive scattering, nonadiabatic processes, statistical theories unimolecular reactions, and the application of laser and molecular beam techniques to the study of reaction mechanisms the quantum description of chemical reactions. The scattering matrix. The calculation of reaction cross sections, probabi rate constants. Collision lifetimes and resonances. Classical trajectories. The two terms can be taken independently. Inst Okumura, Marcus, Kuppermann.

Ch/ChE 140 ab. Principles and Applications of Semiconductor Photoelectrochemistry. *6 units (4-0-2); second, terms. Prerequisite: APh/EE 9 or instructor's permission.* The properties and photoelectrochemistry of semiconductors ar semiconductor/liquid junction solar cells will be discussed. Topics include optical and electronic properties of semiconduc electronic properties of semiconductor junctions with metals, liquids, and other semiconductors, in the dark and under il with emphasis on semiconductor/liquid junctions in aqueous and nonaqueous media. Problems currently facing

semiconductor/liquid junctions and practical applications of these systems will be highlighted. The course will meet for fc hour lectures per week and will be in a tutorial format with instruction predominantly from graduate students and postdc fellows with expertise in the field. Instructor: Lewis. Given in alternate years; not offered 2006–07.

Ch 142. Frontiers in Chemical Biology. *4 units (2-0-2); second term. Prerequisite: Bi/Ch 110 or instructor's permissi* discussion of enzyme structure and function, and ligand-protein-nucleic acid interactions. Not offered 2006–07.

Ch 143. Basic FT NMR Spectroscopy. *9 units (3-2-4); second term. Prerequisite: Ch 41 abc.* The course will cover NM and applications, with emphasis on FT NMR and the principles of multipulse NMR techniques used in structural analysis, determination of relaxation times, INEPT, DEPT, NOSEY, and COSY. A number of NMR techniques will be illustrated with Chapman-Russell *FT NMR Problems* videodisc-based computer program, which features on-screen spectra at a variety o fields with, and without, decoupling, 2-D spectra, and so on. The practical use of NMR will be further demonstrated by la exercises using modern pulse FT NMR techniques with high-field spectrometers for structural analysis. Instructor: J. D. I

Ch 144 ab. Advanced Organic Chemistry. *9 units (3-0-6); first term. Prerequisite: Ch 41 abc; Ch 21 abc recommenc* advanced survey of selected topics in modern physical organic chemistry. Topics vary from year to year and may include and theoretical organic chemistry; molecular recognition/supramolecular chemistry; reaction mechanisms and the tools them; reactive intermediates; materials chemistry; pericyclic reactions; and photochemistry. In 2006–07, only part a wi (first term). Instructor: Dougherty.

Ch 145. Bioorganic Chemistry of Proteins. *9 units (3-0-6); second term. Prerequisite: Ch 41 abc; Bi/Ch 110 recomm* advanced survey of current and classic topics in bioorganic chemistry/chemical biology. The content will vary from year may include the structure, function, and synthesis of peptides and proteins; enzyme catalysis and inhibition; carbohydra glycobiology; chemical genetics; genomics and proteomics; posttranslational modifications; chemical tools to study cellu dynamics; and enzyme evolution. Instructor: Hsieh-Wilson.

Ch 146. Bioorganic Chemistry of Nucleic Acids. *9 units (3-0-6); third term. Prerequisite: Ch 41 ab.* The course will the bioorganic chemistry of nucleic acids, including DNA and RNA structures, molecular recognition, and mechanistic ana covalent modification of nucleic acids. Topics include synthetic methods for the construction of DNA and RNA; separatior techniques; recognition of duplex DNA by peptide analogs, proteins, and oligonucleotide-directed triple helical formation structure and RNA as catalysts (ribozymes). Given in alternate years; not offered 2006–07.

Ch/ChE 147. Polymer Chemistry. *9 units (3-0-6); second term. Prerequisite: Ch 41 abc.* An introduction to the chem polymers, including synthetic methods, mechanisms and kinetics of macromolecule formation, and characterization tech offered 2006–07.

ChE/Ch 148. Polymer Physics. *9 units (3-0-6).* For course description, see Chemical Engineering.

Ch 153. Advanced Inorganic Chemistry. *9 units (2-0-7); second term. Prerequisites: Ch 112 and Ch 21 abc or concu registration.* Topics in modern inorganic chemistry. Electronic structure, spectroscopy, and photochemistry with emphas examples from the modern research literature. Instructor: Gray.

Ch 154 ab. Organometallic Chemistry. *9 units (3-0-6); second, third terms. Prerequisite: Ch 112 or equivalent.* A ge discussion of the reaction mechanisms and the synthetic and catalytic uses of transition metal organometallic compound term: a survey of the elementary reactions and methods for investigating reaction mechanisms. Third term: contempora inorganic and organometallic synthesis, structure and bonding, and applications in catalysis. Instructors: Bercaw, Peters

ChE/Ch 155. Chemistry of Catalysis. *9 units (3-0-6).* For course description, see Chemical Engineering.

Ch 163. Lectures-Seminars in Physical Chemistry. *6 units (2-0-4); third term.* Not offered 2006–07.

ChE/Ch 164. Introduction to Statistical Thermodynamics. *9 units (3-0-6).* For course description, see Chemical Er

ChE/Ch 165. Chemical Thermodynamics. *9 units (3-0-6).* For course description, see Chemical Engineering.

Ch 166. Nonequilibrium Statistical Mechanics. *9 units (3-0-6); third term. Prerequisite: Ch 21 abc or equivalent.* Tr processes in dilute gases; Boltzmann equation; Brownian motion; Langevin and Fokker-Planck equations; linear respons time-correlation functions and applications; nonequilibrium thermodynamics. Instructor: Marcus.

BMB/Bi/Ch 170. Principles of Three-Dimensional Protein Structure. *9 units (3-3-3).* For course description, see Biochemistry and Molecular Biophysics.

ESE/Ge/Ch 171. Atmospheric Chemistry I. *9 units (3-0-6).* For course description, see Environmental Science and E

ESE/Ge/Ch 172. Atmospheric Chemistry II. *3 units (3-0-0).* For course description, see Environmental Science and Engineering.

BMB/Bi/Ch 174. Biophysical Chemistry. *9 units (3-0-6).* For course description, see Biochemistry and Molecular Bio

ESE/Ch/Ge 175 ab. Environmental Organic Chemistry. *9 units (3-0-6).* For course description, see Environmental Engineering.

Ch 180. Chemical Research. *Units by arrangement. Offered to M.S. candidates in chemistry,* Graded pass/fail.

Ch 212. Bioinorganic Chemistry. *9 units (3-0-6); third term. Prerequisites: Ch 112 and Bi/Ch 110 or equivalent.* Curr in bioinorganic chemistry will be discussed, including metal storage and regulation, metalloenzyme structure and reactio biological electron transfer, metalloprotein design, and metal-nucleic acid interactions and reactions. Instructor: Barton. alternate years; not offered 2006–07.

Ch 213 abc. Advanced Ligand Field Theory. *12 units (1-0-11); first, second, third terms. Prerequisite: Ch 21 abc or registration.* A tutorial course of problem solving in the more advanced aspects of ligand field theory. Recommended onl students interested in detailed theoretical work in the inorganic field. Instructors: Gray, staff.

Ch 221. Electron Transfer Reactions in Chemistry and Biology. *6 units; second term. Prerequisite: Ch 21 abc.* Fun of electron transfer reactions. Molecular (statistical) theory, dielectric continua, electronic matrix elements, Franck-Cond principle, relevant thermodynamics, reorganization energy, quantum effects, charge transfer spectra, solvent dynamics. in solution at metal electrode-liquid, modified electrode-liquid, semiconductor electrode-liquid, and liquid-liquid interface theory. Reactions in photosynthetic reaction centers and in other proteins. Not offered 2006–07.

Ch 224. Advanced Topics in Magnetic Resonance. *9 units (2-0-7); third term. Prerequisite: Ch 125 abc or Ph 125 a concurrent registration or equivalent; Ch 122 b or equivalent.* A detailed presentation of some of the important concepts magnetic resonance unified by the spin density operator formalism. Topics will include both classic phenomena and rece development, especially in solid-state and two-dimensional NMR. Instructor: Weitekamp. Not offered 2006–07.

Ch 227 ab. Advanced Topics in Chemical Physics. *9 units (3-0-6); part a second term; part b third term. Prerequisi abc or Ph 125 abc or equivalent.* The general quantum mechanical theory of molecular collisions will be presented in det classical, semi-classical, and other approximations. Applications to inelastic and reactive molecule-molecule and inelastic molecule collisions. Part a not offered 2006–07. Instructor: Heath.

Ch 228. Dynamics and Complexity in Physical and Life Sciences. *9 units (3-0-6); third term.* This course is concer the dynamics of molecular systems, with particular focus on complexity, the elementary motions that lead to functions i and biological assemblies. It will address principles of dynamics as they relate to the nature of the chemical bond. An ov modern techniques, such as those involving lasers, NMR, and diffraction, for unraveling dynamics in complex systems. A from areas of physics, chemistry, and biology—from coherence and chaos to molecular recognition and self-assembly. Ir Zewail.

Ch/Bi 231. Advanced Topics in Biochemistry. *6 units (2-0-4); third term.* Transcriptional Regulation in Eukaryotes. subunit structure of eukaryotic RNA polymerases and their role in transcriptional reactions; the composition of eukaryoti promoters, including regulatory units; general and specific transcription factors; developmental regulatory circuits and f structural motifs involved in DNA binding and transcriptional initiation and control. Not offered 2006–07.

Ch 242 ab. Chemical Synthesis. *9 units (3-0-6); first, second terms. Prerequisite: Ch 41 abc.* An integrated approach synthetic problem solving featuring an extensive review of modern synthetic reactions with concurrent development of s for synthesis design. Part a will focus on the application of modern methods of stereocontrol in the construction of stere complex acyclic systems. Part b will focus on strategies and reactions for the synthesis of cyclic systems. Instructors: St

Ch 244. Topics in Chemical Biology. *9 units; second term.* Current topics at the interface of chemistry and biology. N 2006–07.

Ch 247. Organic Reaction Mechanisms. *6 units (2-0-4); third term.* A mechanistic view of free-radical reactions usin from biological systems. Topics: initiation, termination, and propagation of radical reactions in vivo, mechanisms of lipid spin labeling, photosynthesis, oxygen radicals and oxygen toxicity, and radical reactions in proteins and nucleic acids. N 2006–07.

Ch 250. Advanced Topics in Chemistry. *Units and term to be arranged.* Content will vary from year to year; topics a according to interests of students and staff. Visiting faculty may present portions of this course. Not offered 2006–07.

Ch 280. Chemical Research. *Hours and units by arrangement.* By arrangement with members of the faculty, properly graduate students are directed in research in chemistry.